Princeton University

Modern Equipment General Aviation (MEGA) Aircraft

Progress Report

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MAE 439

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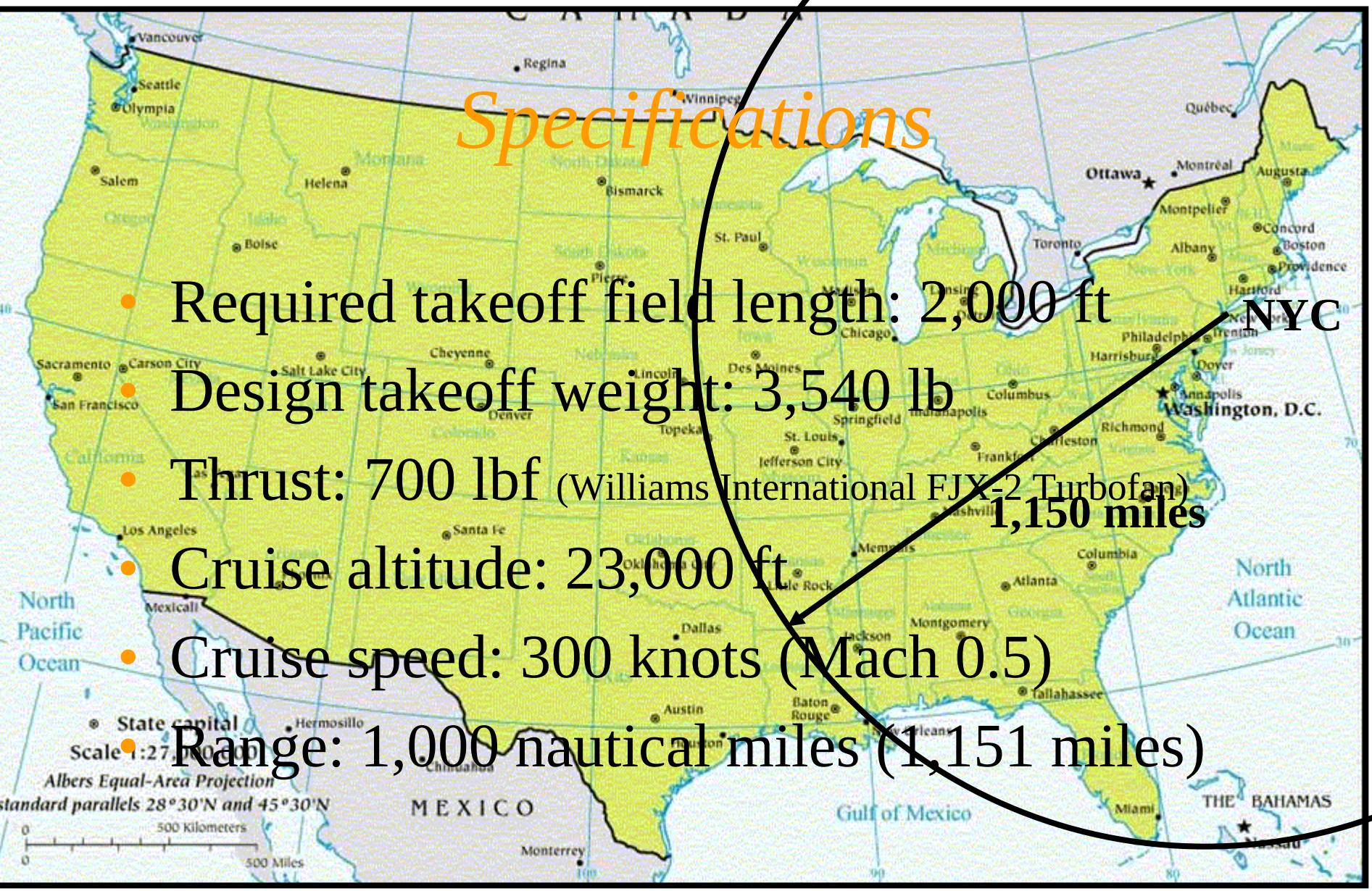
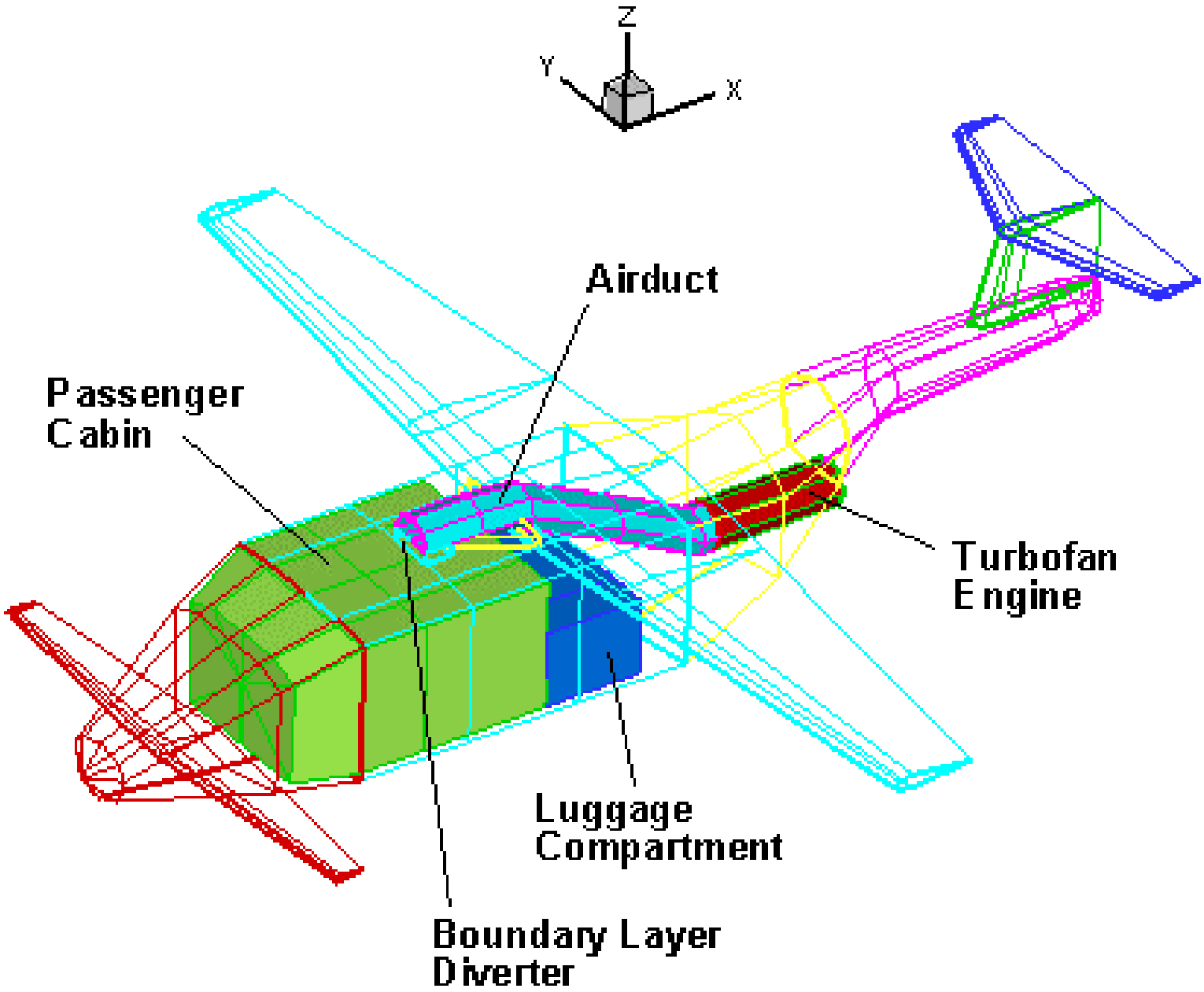
Specifications

- Required takeoff field length: 2,000 ft
- Design takeoff weight: 3,540 lb
- Thrust: 700 lbf (Williams International FJX-2 Turbofan)
- Cruise altitude: 23,000 ft
- Cruise speed: 300 knots (Mach 0.5)
- Range: 1,000 nautical miles (1,151 miles)




Z
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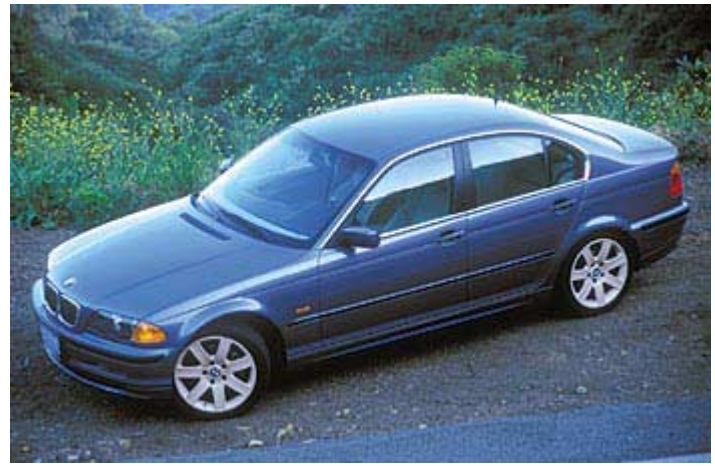
Airduct
Passenger Cabin
Turbofan Engine
Luggage Compartment
Boundary Layer Diverter

Interior



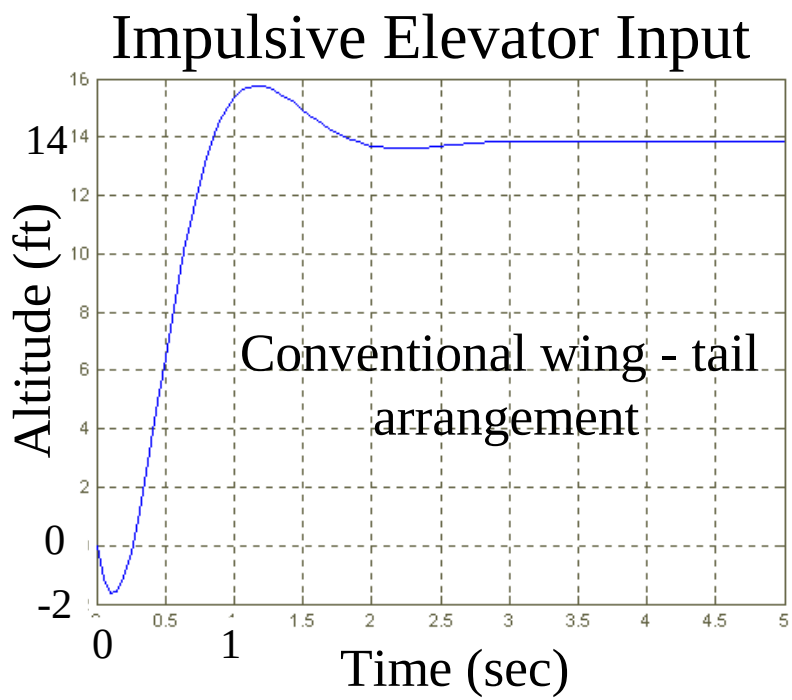
- Passenger Cabin:
  - 4 passengers
  - Pressurized
  - Total volume: 105 ft^3
  - Dimensions:
    - Length: 6.7 ft
    - Width: 4.6 ft
    - Height: 3.4 ft

- Luggage Compartment:
  - Inside and outside accessibility
  - Total volume: 18 ft^3
  - Dimensions:
    - Length: 2.6 ft
    - Width: 3.5 ft
    - Height: 2.0 ft

4 X

Why Three Surfaces?

- More room for redundant control surfaces
- Canard provides additional lift during takeoff (flaperons)
- Better transient response to pitch input



- Stall behavior (plane designed to stall first at canard and last at tail)
- Disadvantage: increase in drag and weight

Canard

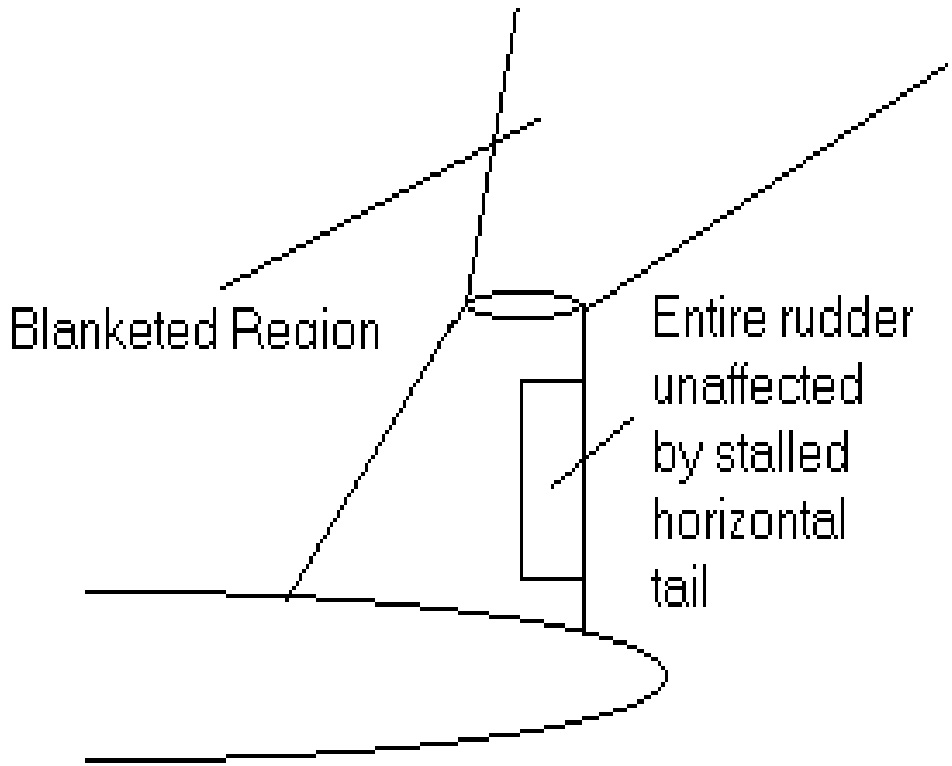
- Surface area: 17.2 ft^2
- Span: 13.1 ft
- High aspect ratio: AR = 10 (+ winglets)
  - minimize downwash and drag
  - stalls earlier than wing
- Thickness ratio: t/c = 0.15 (gradual stall)
- Twist to prevent tip stall
- Nearly elliptical lift distribution (taper, twist)

Wing

- Surface area: 97.2 ft^2
- Span: 27.9 ft
- Aspect ratio: AR = 8 (+ winglets)
- High wing design:
  - easy accessibility
  - little ground effects
  - structural advantages
  - short landing gear (retractable)
- Thick wing (t/c = 0.15)

T-Tail?

- Better for spin recovery
- More efficient yaw control



T-Tail

Airduct Location

- Minimize risk of engine stall
- Options: chin, nose, armpit, top
- Top of fuselage:
  - simple duct geometry (no split duct)
  - clean air (no disturbances due to canard or nose wheel)
  - fuselage can be designed to avoid flow separation at high angles of attack and sideslip

Weights

- Empty: 1,744 lb
- Passengers (max.): 880 lb
- Luggage (max): 355 lb
- Fuel: 561 lb (15% canard, 85% wing)

- Design takeoff gross weight: 3,540 lb

Weight Build Up

- Wing*: 149 lb
- Canard*: 45 lb
- Tail*: 19 lb
- Fuselage*: 326 lb
- Landing gear: 217 lb
- Engine & fuel sys: 259
- Avionics: 119

- A/c & anti ice: 102
- Flight Controls, hydraulics, and electronics **: 228
- Miscellaneous: 281

(all weights in lb)

*Composites

** likely to change

Future Work

- Aircraft:
  - Exact locations of interior components: center of gravity & moments of inertia
  - Aerodynamic force and moment coefficients (CFD)
- Architecture:
  - Actual reliability statistics
  - Control laws for redundancy and dynamics

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